Slides: bit.ly/2S11nyg

KubeCon | CloudNativeCon

North America 2018

SIG-Testing Deep Dive

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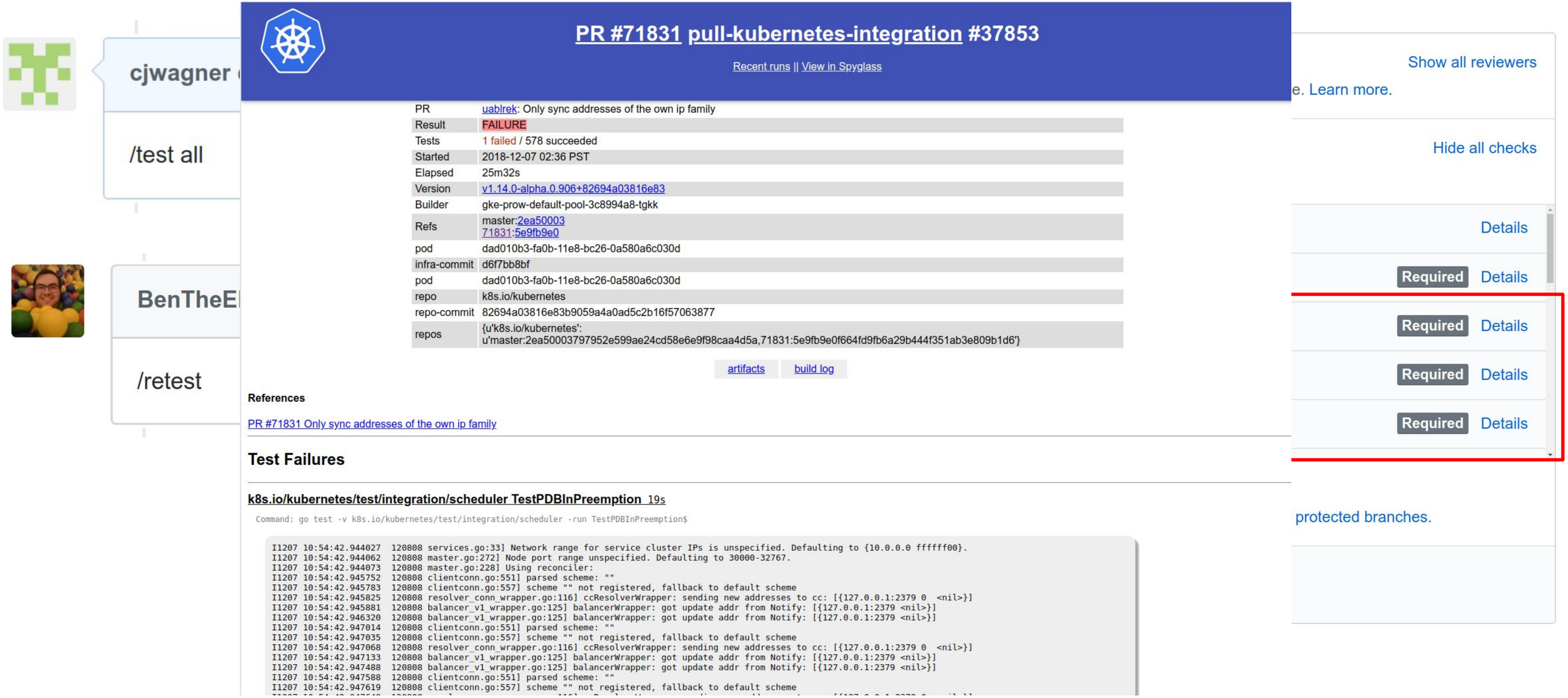
Prow

- CI/CD system built on Kubernetes for Kubernetes
- Executes jobs for building, testing, publishing, and deploying.
- Jobs can be triggered by different types of events and report their status to many different services.
- Also provides GitHub automation:
  - Policy enforcement.
  - Chat-ops via `/foo` style commands.
  - Automatic pull request merging.
- Used by:

Kubeflow
OPENSHIFT

ProwJobs



cjwagner

/test all

BenTheE

/retest

Show all reviewers

e. Learn more.

Hide all checks

Details

Required Details

Required Details

Required Details

Required Details

Required Details

protected branches.

PR #71831 pull-kubernetes-integration #37853

Recent runs || View in Spyglass

PR	uablrek: Only sync addresses of the own ip family
Result	FAILURE
Tests	1 failed / 578 succeeded
Started	2018-12-07 02:36 PST
Elapsed	25m32s
Version	v1.14.0-alpha.0.906+82694a03816e83
Builder	gke-prow-default-pool-3c8994a8-tgkk
Refs	master:2ea50003 71831:5e9fb9e0
pod	dad010b3-fa0b-11e8-bc26-0a580a6c030d
infra-commit	d6f7bb8bf
pod	dad010b3-fa0b-11e8-bc26-0a580a6c030d
repo	k8s.io/kubernetes
repo-commit	82694a03816e83b9059a4a0ad5c2b16f57063877
repos	{u'k8s.io/kubernetes': u'master:2ea50003797952e599ae24cd58e6e9f98caa4d5a,71831:5e9fb9e0f664fd9fb6a29b444f351ab3e809b1d6'}

artifacts build log

References

PR #71831 Only sync addresses of the own ip family

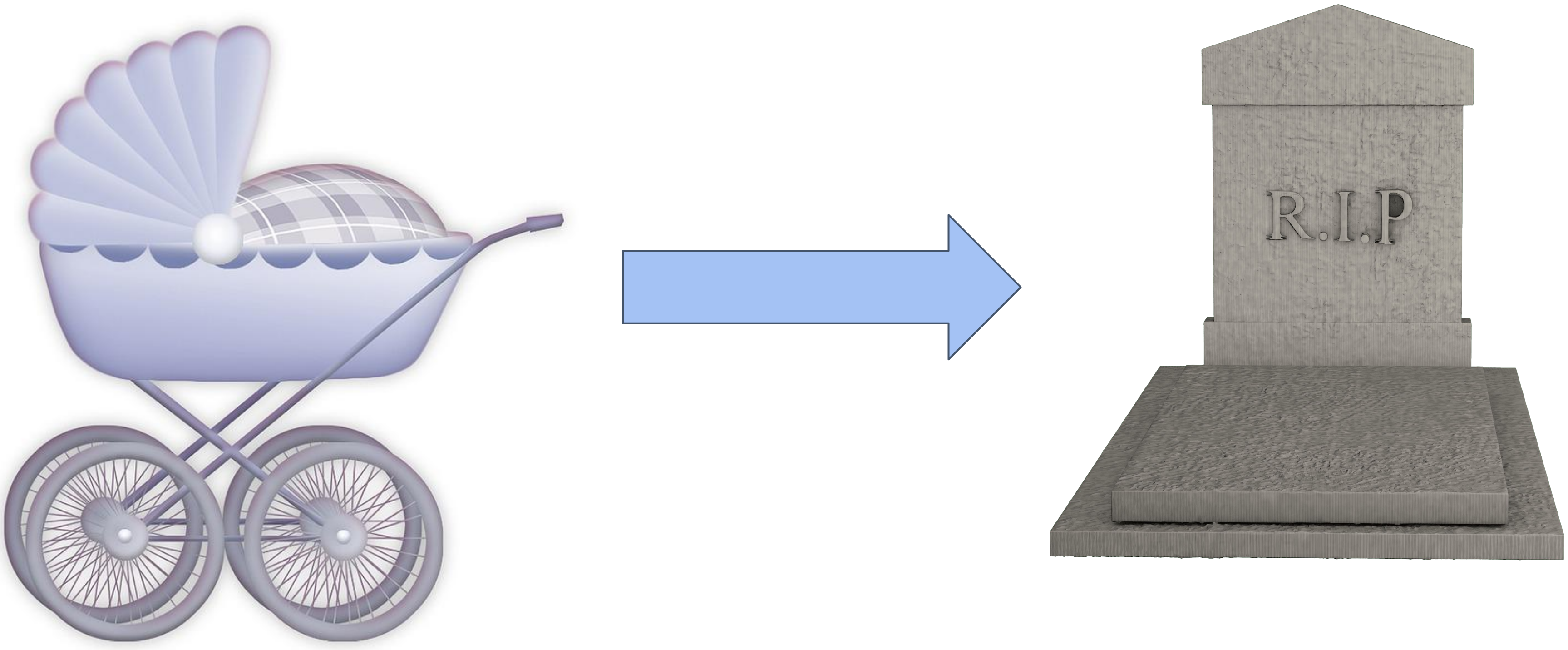
Test Failures

k8s.io/kubernetes/test/integration/scheduler TestPDBInPreemption 19s

```
Command: go test -v k8s.io/kubernetes/test/integration/scheduler -run TestPDBInPreemption$
```

```
I1207 10:54:42.944027  120808 services.go:33] Network range for service cluster IPs is unspecified. Defaulting to {10.0.0.0 ffffff00}.
I1207 10:54:42.944062  120808 master.go:272] Node port range unspecified. Defaulting to 30000-32767.
I1207 10:54:42.944073  120808 master.go:228] Using reconciler:
I1207 10:54:42.945752  120808 clientconn.go:551] parsed scheme: ""
I1207 10:54:42.945783  120808 clientconn.go:557] scheme "" not registered, fallback to default scheme
I1207 10:54:42.945825  120808 resolver_conn_wrapper.go:116] ccResolverWrapper: sending new addresses to cc: [{127.0.0.1:2379 0  <nil>}]
I1207 10:54:42.945881  120808 balancer_v1_wrapper.go:125] balancerWrapper: got update addr from Notify: [{127.0.0.1:2379 <nil>}]
I1207 10:54:42.946320  120808 balancer_v1_wrapper.go:125] balancerWrapper: got update addr from Notify: [{127.0.0.1:2379 <nil>}]
I1207 10:54:42.947014  120808 clientconn.go:551] parsed scheme: ""
I1207 10:54:42.947035  120808 clientconn.go:557] scheme "" not registered, fallback to default scheme
I1207 10:54:42.947068  120808 resolver_conn_wrapper.go:116] ccResolverWrapper: sending new addresses to cc: [{127.0.0.1:2379 0  <nil>}]
I1207 10:54:42.947133  120808 balancer_v1_wrapper.go:125] balancerWrapper: got update addr from Notify: [{127.0.0.1:2379 <nil>}]
I1207 10:54:42.947488  120808 balancer_v1_wrapper.go:125] balancerWrapper: got update addr from Notify: [{127.0.0.1:2379 <nil>}]
I1207 10:54:42.947588  120808 clientconn.go:551] parsed scheme: ""
I1207 10:54:42.947619  120808 clientconn.go:557] scheme "" not registered, fallback to default scheme
```

Life of a ProwJob



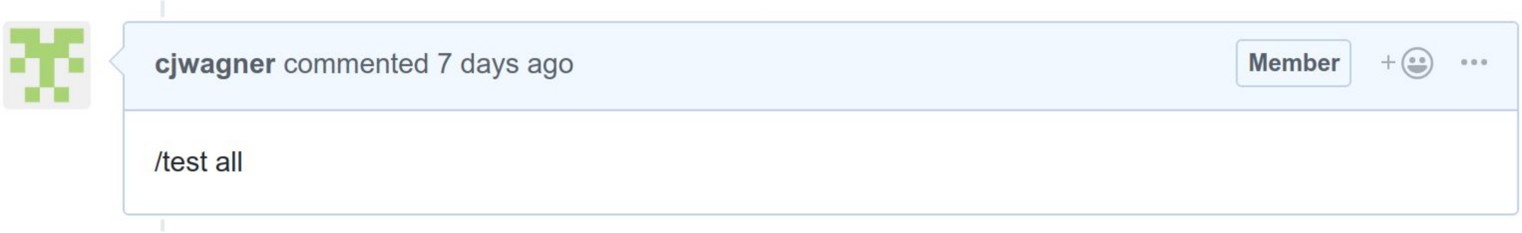
Life of a ProwJob

~~ProwJobs support many different~~

- ~~Job types~~
- ~~Triggering mechanisms~~
- ~~Execution platforms~~
- ~~Reporting sinks~~

Only going to talk about
=> Presubmit
=> `/test all`
=> Kubernetes Pod
=> GitHub status context

Life of a ProwJob



cjwagner commented 7 days ago

/test all

GitHub webhook payload:

```
{
  "comment": {
    "body": "/test all",
      ...
    "user": {
      "login": "cjwagner",
    },
  },
  "repository": {
    "full_name": "kubernetes/test-infra",
      ...
  },
  "action": "created",
  "issue": {
    ...
  }
}
```

Webhook Event | Hook | Plank | Sinker | Crier

Life of a ProwJob

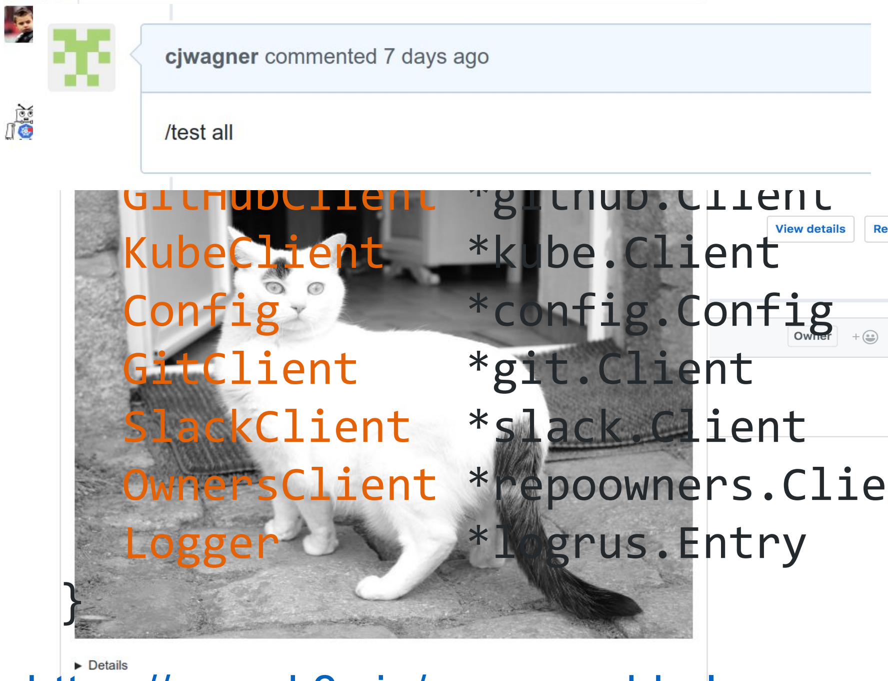
Ingress Rule -> Service -> Deployment

```yaml
rules:
- host: prow.k8s.io
  http:
    paths:
    - path: /*
      backend:
        serviceName: deck
        servicePort: 80
    - path: /hook
      backend:
        serviceName: hook
        servicePort: 8888
```

```yaml
apiVersion: v1
kind: Service
metadata:
 name: hook
spec:
 selector:
   app: hook
 ports:
 - port: 8888
 type: NodePort
```

```yaml
apiVersion: extensions/v1beta1
kind: Deployment
metadata:
 name: hook
spec:
    ...
 template:
   metadata:
     labels:
       app: hook
   spec:
       ...
```

Life of a ProwJob



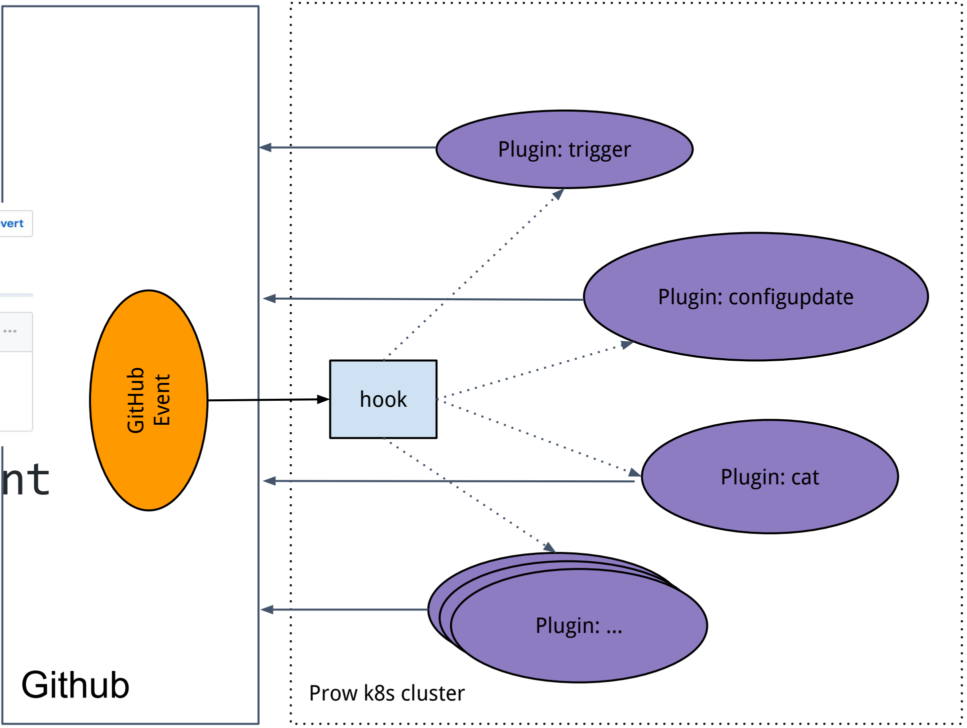
cjwagner commented 7 days ago

/test all

View details
Revert
Owner
▸ Details

```
GitHubClient  *github.Client
KubeClient    *kube.Client
Config        *config.Config
GitClient     *git.Client
SlackClient   *slack.Client
OwnersClient  *repoowners.Client
Logger        *logrus.Entry
}
```

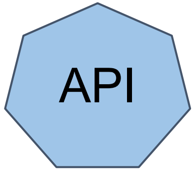
https://prow.k8s.io/command-help



Webhook Event | Hook | Plank | Sinker | Crier

Life of a ProwJob

- `trigger` plugin determines which jobs to run based on the config.
- Creates a new ProwJob custom resource for each job ->
- CRDs lets us store state in the Kubernetes API server.



```yaml
apiVersion: prow.k8s.io/v1
kind: ProwJob
metadata:
  name: 32456927-35d9-11e7-8d95-0a580a6c1504
spec:
  job: pull-test-infra-bazel
  decorate: true
  pod_spec:
    containers:
    - image: gcr.io/k8s-testimages/bazelbuild:0.11
  refs:
    base_ref: master
    base_sha: 064678510782db5b382df478bb374aaa32e577ea
    org: kubernetes
    pulls:
    - author: ixdy
      number: 2716
      sha: dc32ccc9ea3672ccc523b7cbaa8b00360b4183cd
    repo: test-infra
  type: presubmit
status:
  state: triggered
```

Webhook Event | Hook | Plank | Sinker | Crier

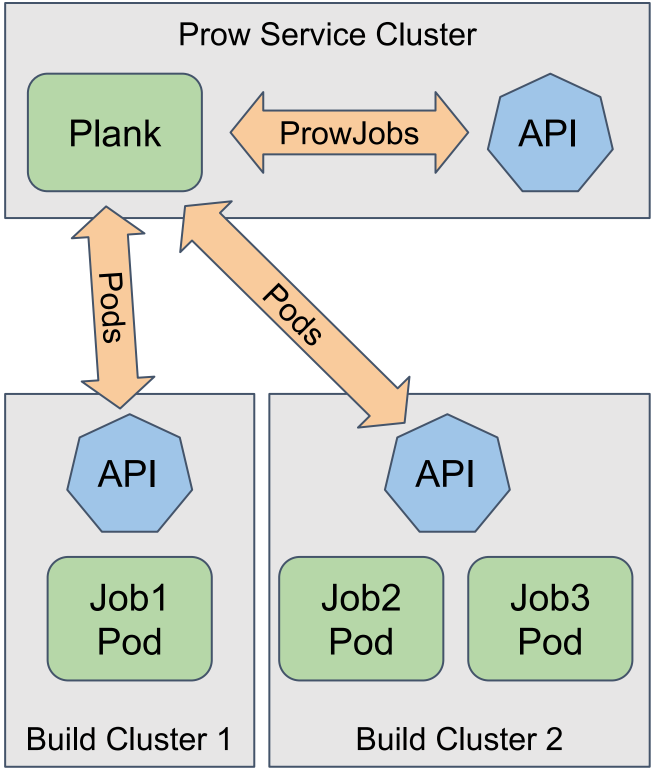
Life of a ProwJob

- Plank syncs ProwJob CRDs with Pods.
- Typical lifecycle:
  - New PJ without a pod

    => Create pod
  - Running PJ with completed pod

    => Complete the PJ (Pass/Fail)
  - Complete PJ

    => Ignore



Life of a ProwJob

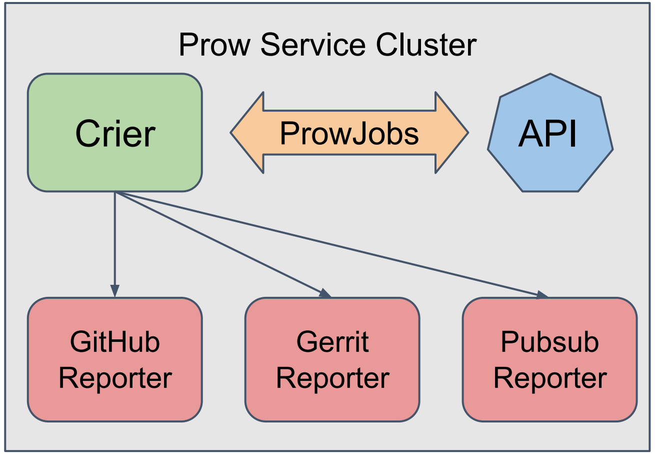
- Sinker is responsible for garbage collection.
  - Completed ProwJobs: after 2 days
  - Completed Pods: after 30 minutes

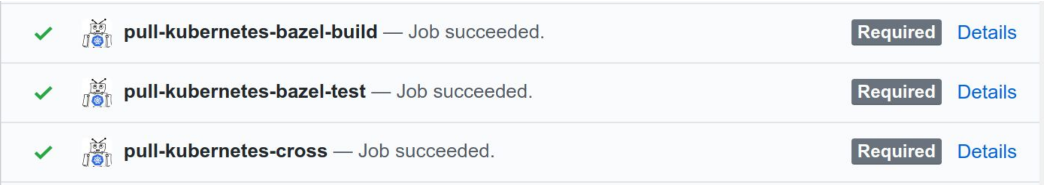
- Historic results are served from GCS

Life of a ProwJob

- Crier detects changes to ProwJob CRDs and notifies reporting clients.

- Clients report job status to external services.
  - GitHub status context
  - Gerrit comment
  - Pubsub message



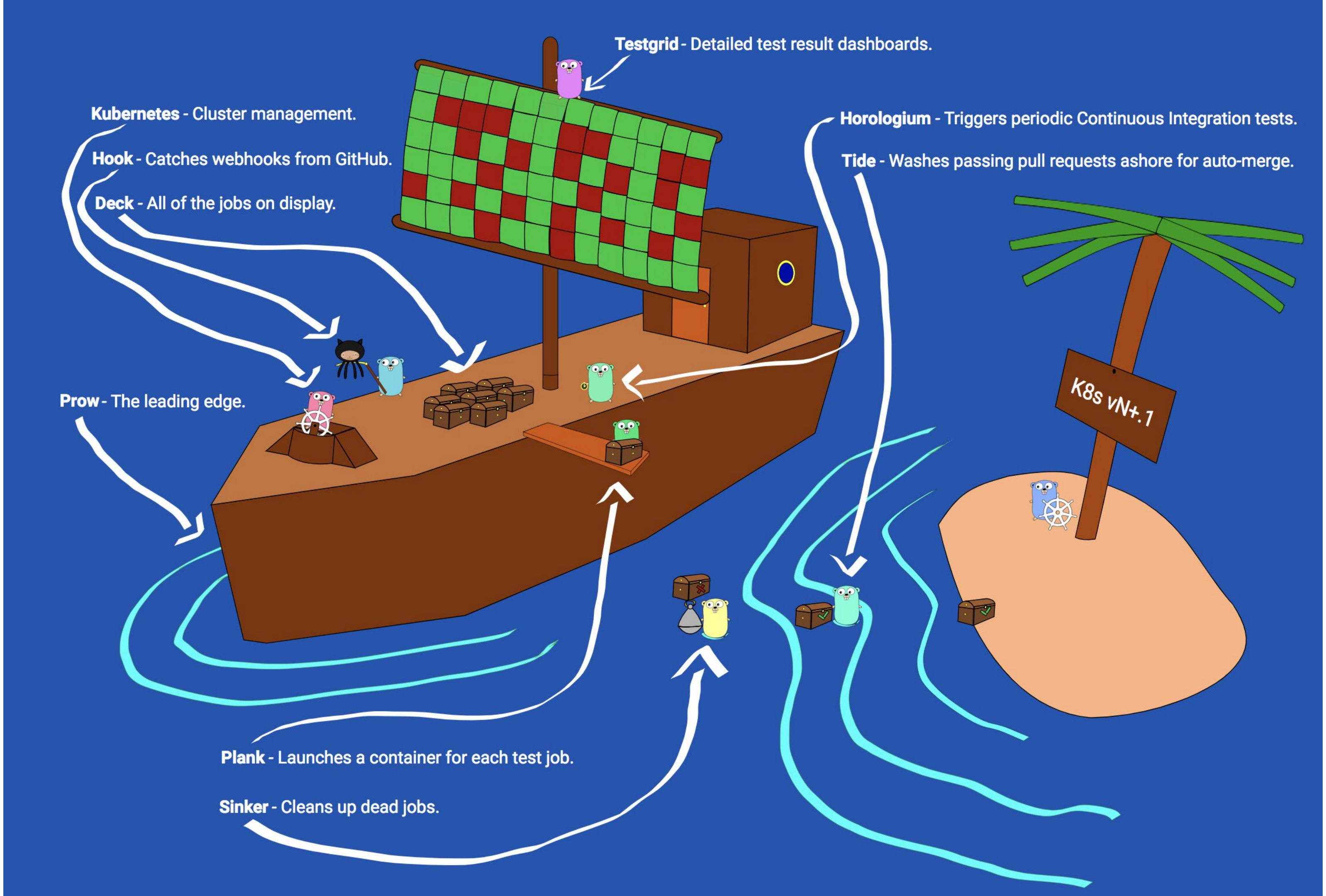


✓ **pull-kubernetes-bazel-build** — Job succeeded. Required Details

✓ **pull-kubernetes-bazel-test** — Job succeeded. Required Details

✓ **pull-kubernetes-cross** — Job succeeded. Required Details

Webhook Event | Hook | Plank | Sinker | Crier



Testgrid - Detailed test result dashboards.

Kubernetes - Cluster management.

Hook - Catches webhooks from GitHub.

Deck - All of the jobs on display.

Horologium - Triggers periodic Continuous Integration tests.

Tide - Washes passing pull requests ashore for auto-merge.

Prow - The leading edge.

Plank - Launches a container for each test job.

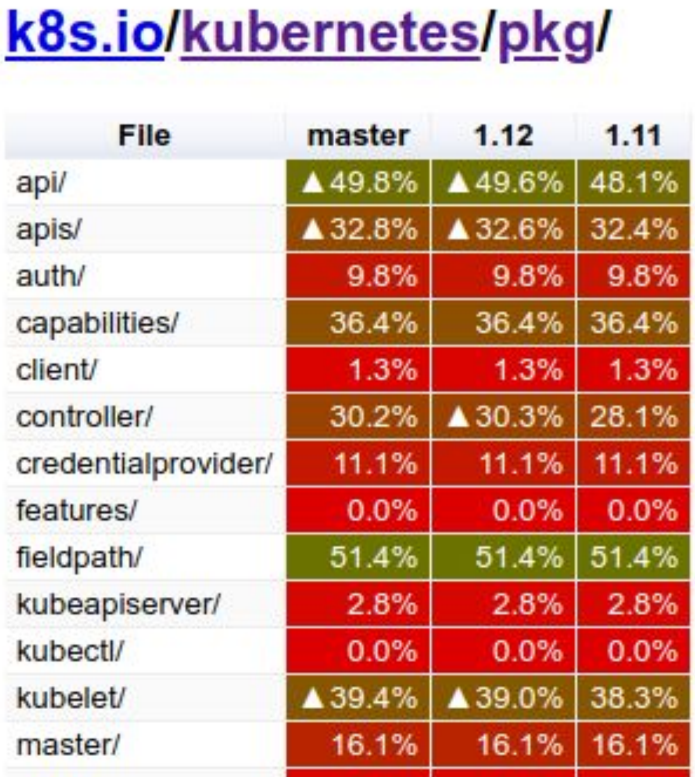
Sinker - Cleans up dead jobs.

Congrats Ben!

Bugs Hate Him!

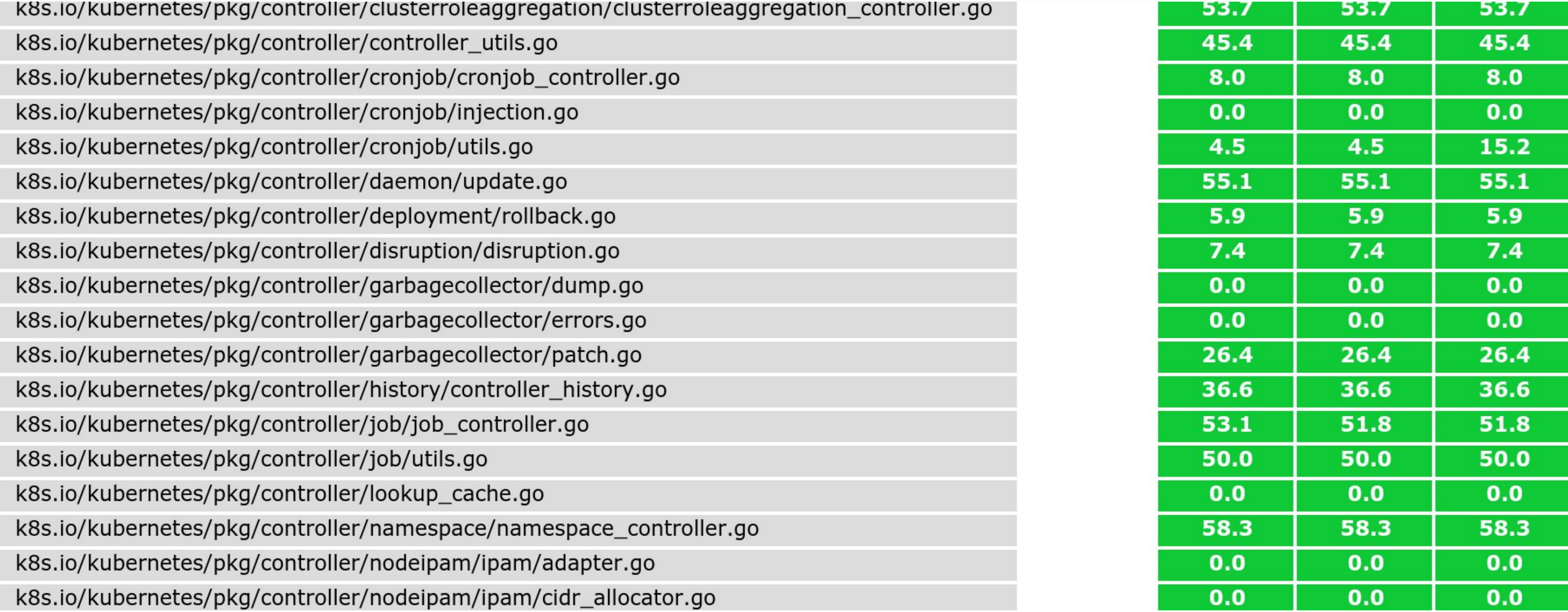
Local developer discovers where bugs hide from e2e tests. Learn this one WEIRD trick to his STUNNING results!

LEARN THE TRUTH NOW



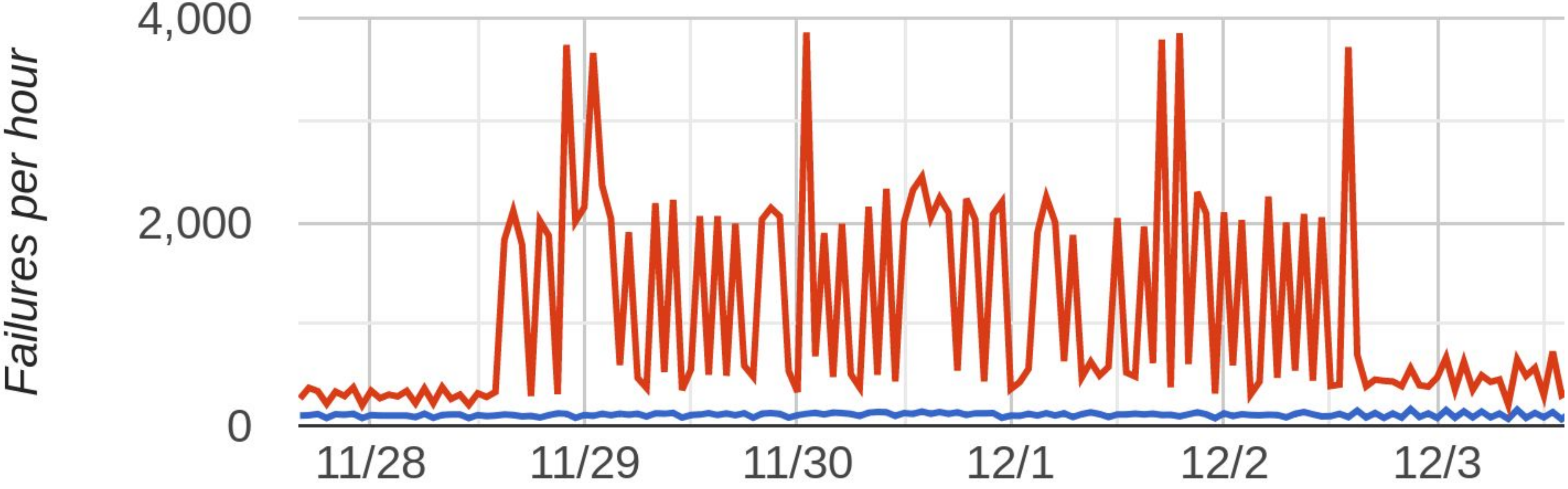
k8s.io/kubernetes/pkg/

File	master	1.12	1.11
api/	▲49.8%	▲49.6%	48.1%
apis/	▲32.8%	▲32.6%	32.4%
auth/	9.8%	9.8%	9.8%
capabilities/	36.4%	36.4%	36.4%
client/	1.3%	1.3%	1.3%
controller/	30.2%	▲30.3%	28.1%
credentialprovider/	11.1%	11.1%	11.1%
features/	0.0%	0.0%	0.0%
fieldpath/	51.4%	51.4%	51.4%
kubeapiserver/	2.8%	2.8%	2.8%
kubectl/	0.0%	0.0%	0.0%
kubelet/	▲39.4%	▲39.0%	38.3%
master/	16.1%	16.1%	16.1%



k8s.io/kubernetes/pkg/controller/clusterroleaggregation/clusterroleaggregation_controller.go	53.7	53.7	53.7
k8s.io/kubernetes/pkg/controller/controller_utils.go	45.4	45.4	45.4
k8s.io/kubernetes/pkg/controller/cronjob/cronjob_controller.go	8.0	8.0	8.0
k8s.io/kubernetes/pkg/controller/cronjob/injection.go	0.0	0.0	0.0
k8s.io/kubernetes/pkg/controller/cronjob/utils.go	4.5	4.5	15.2
k8s.io/kubernetes/pkg/controller/daemon/update.go	55.1	55.1	55.1
k8s.io/kubernetes/pkg/controller/deployment/rollback.go	5.9	5.9	5.9
k8s.io/kubernetes/pkg/controller/disruption/disruption.go	7.4	7.4	7.4
k8s.io/kubernetes/pkg/controller/garbagecollector/dump.go	0.0	0.0	0.0
k8s.io/kubernetes/pkg/controller/garbagecollector/errors.go	0.0	0.0	0.0
k8s.io/kubernetes/pkg/controller/garbagecollector/patch.go	26.4	26.4	26.4
k8s.io/kubernetes/pkg/controller/history/controller_history.go	36.6	36.6	36.6
k8s.io/kubernetes/pkg/controller/job/job_controller.go	53.1	51.8	51.8
k8s.io/kubernetes/pkg/controller/job/utils.go	50.0	50.0	50.0
k8s.io/kubernetes/pkg/controller/lookup_cache.go	0.0	0.0	0.0
k8s.io/kubernetes/pkg/controller/namespace/namespace_controller.go	58.3	58.3	58.3
k8s.io/kubernetes/pkg/controller/nodeipam/ipam/adapter.go	0.0	0.0	0.0
k8s.io/kubernetes/pkg/controller/nodeipam/ipam/cidr_allocator.go	0.0	0.0	0.0

https://testgrid.k8s.io/sig-testing-canaries#ci-kubernetes-coverage-conformance


Failures per hour
4,000
2,000
0
11/28
11/29
11/30
12/1
12/2
12/3

Using e2e coverage

- Build time: `make KUBE_BUILD_WITH_COVERAGE=yes`
- Run time:
  - Destination: `KUBE_COVERAGE_FILE` (default: `/tmp/k8s-component.cov`)
  - Flush interval: `KUBE_COVERAGE_FLUSH_INTERVAL` (default: 5s)
  - Run any workload of your choosing
- Collect results

Using e2e coverage

```
kubetest --up --dump-before-and-after --test --down
```

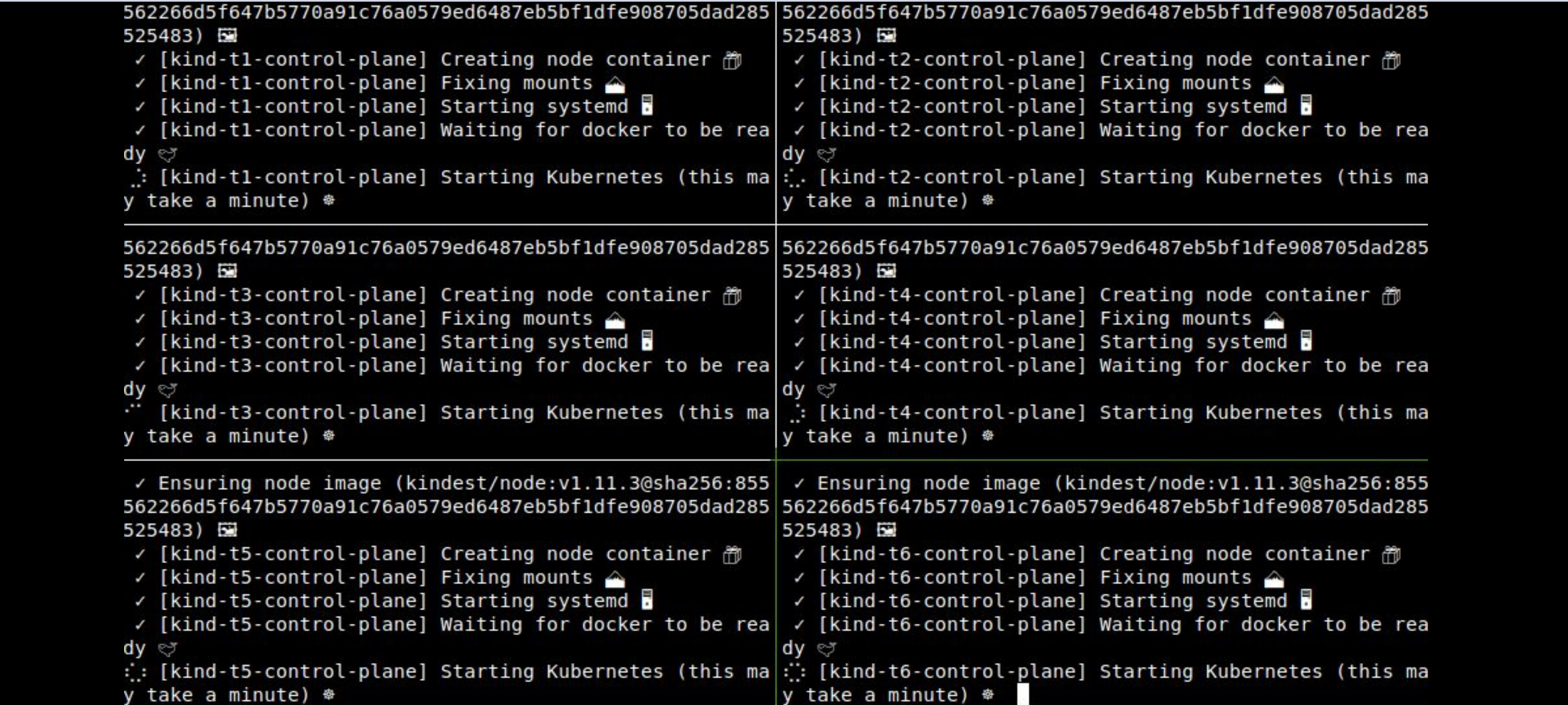
(using the default GCE provider only)

Using e2e coverage

```
$ KUBE_BUILD_WITH_COVERAGE=y kind build node
$ kind create cluster
$ ./kind-coverage-dump.sh 1 before/
$ KUBECONFIG=$(kind get kubeconfig-path) kubetest --test
$ ./kind-coverage-dump.sh 1 after/
```

A fun trick

KubeCon CloudNativeCon North America 2018



```
562266d5f647b5770a91c76a0579ed6487eb5bf1dfe908705dad285
525483) 🖼
 ✓ [kind-t1-control-plane] Creating node container 📦
 ✓ [kind-t1-control-plane] Fixing mounts 🗻
 ✓ [kind-t1-control-plane] Starting systemd 🖥
 ✓ [kind-t1-control-plane] Waiting for docker to be rea
dy 🐋
 ⠼ [kind-t1-control-plane] Starting Kubernetes (this ma
y take a minute) ☸
```

```
562266d5f647b5770a91c76a0579ed6487eb5bf1dfe908705dad285
525483) 🖼
 ✓ [kind-t2-control-plane] Creating node container 📦
 ✓ [kind-t2-control-plane] Fixing mounts 🗻
 ✓ [kind-t2-control-plane] Starting systemd 🖥
 ✓ [kind-t2-control-plane] Waiting for docker to be rea
dy 🐋
 ⡖ [kind-t2-control-plane] Starting Kubernetes (this ma
y take a minute) ☸
```

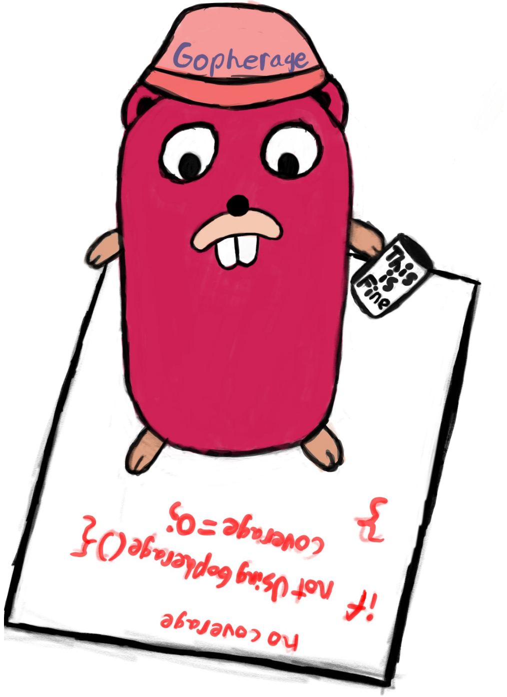
```
562266d5f647b5770a91c76a0579ed6487eb5bf1dfe908705dad285
525483) 🖼
 ✓ [kind-t3-control-plane] Creating node container 📦
 ✓ [kind-t3-control-plane] Fixing mounts 🗻
 ✓ [kind-t3-control-plane] Starting systemd 🖥
 ✓ [kind-t3-control-plane] Waiting for docker to be rea
dy 🐋
 ⠉ [kind-t3-control-plane] Starting Kubernetes (this ma
y take a minute) ☸
```

```
562266d5f647b5770a91c76a0579ed6487eb5bf1dfe908705dad285
525483) 🖼
 ✓ [kind-t4-control-plane] Creating node container 📦
 ✓ [kind-t4-control-plane] Fixing mounts 🗻
 ✓ [kind-t4-control-plane] Starting systemd 🖥
 ✓ [kind-t4-control-plane] Waiting for docker to be rea
dy 🐋
 ⠼ [kind-t4-control-plane] Starting Kubernetes (this ma
y take a minute) ☸
```

```
 ✓ Ensuring node image (kindest/node:v1.11.3@sha256:855
562266d5f647b5770a91c76a0579ed6487eb5bf1dfe908705dad285
525483) 🖼
 ✓ [kind-t5-control-plane] Creating node container 📦
 ✓ [kind-t5-control-plane] Fixing mounts 🗻
 ✓ [kind-t5-control-plane] Starting systemd 🖥
 ✓ [kind-t5-control-plane] Waiting for docker to be rea
dy 🐋
 ⡖ [kind-t5-control-plane] Starting Kubernetes (this ma
y take a minute) ☸
```

```
 ✓ Ensuring node image (kindest/node:v1.11.3@sha256:855
562266d5f647b5770a91c76a0579ed6487eb5bf1dfe908705dad285
525483) 🖼
 ✓ [kind-t6-control-plane] Creating node container 📦
 ✓ [kind-t6-control-plane] Fixing mounts 🗻
 ✓ [kind-t6-control-plane] Starting systemd 🖥
 ✓ [kind-t6-control-plane] Waiting for docker to be rea
dy 🐋
 ⡖ [kind-t6-control-plane] Starting Kubernetes (this ma
y take a minute) ☸
```

Using e2e coverage



Using e2e coverage

- `gopherage merge`: merge a batch of coverage files
- `gopherage diff`: to constrain what coverage counts
- `gopherage aggregate`: to aggregate across multiple runs
- `gopherage junit`: to generate testgrid-compatible coverage data
- `bazel run //gopherage -- html`: generate a browsable report

All use standard go coverage files, so any coverage-related tooling works!

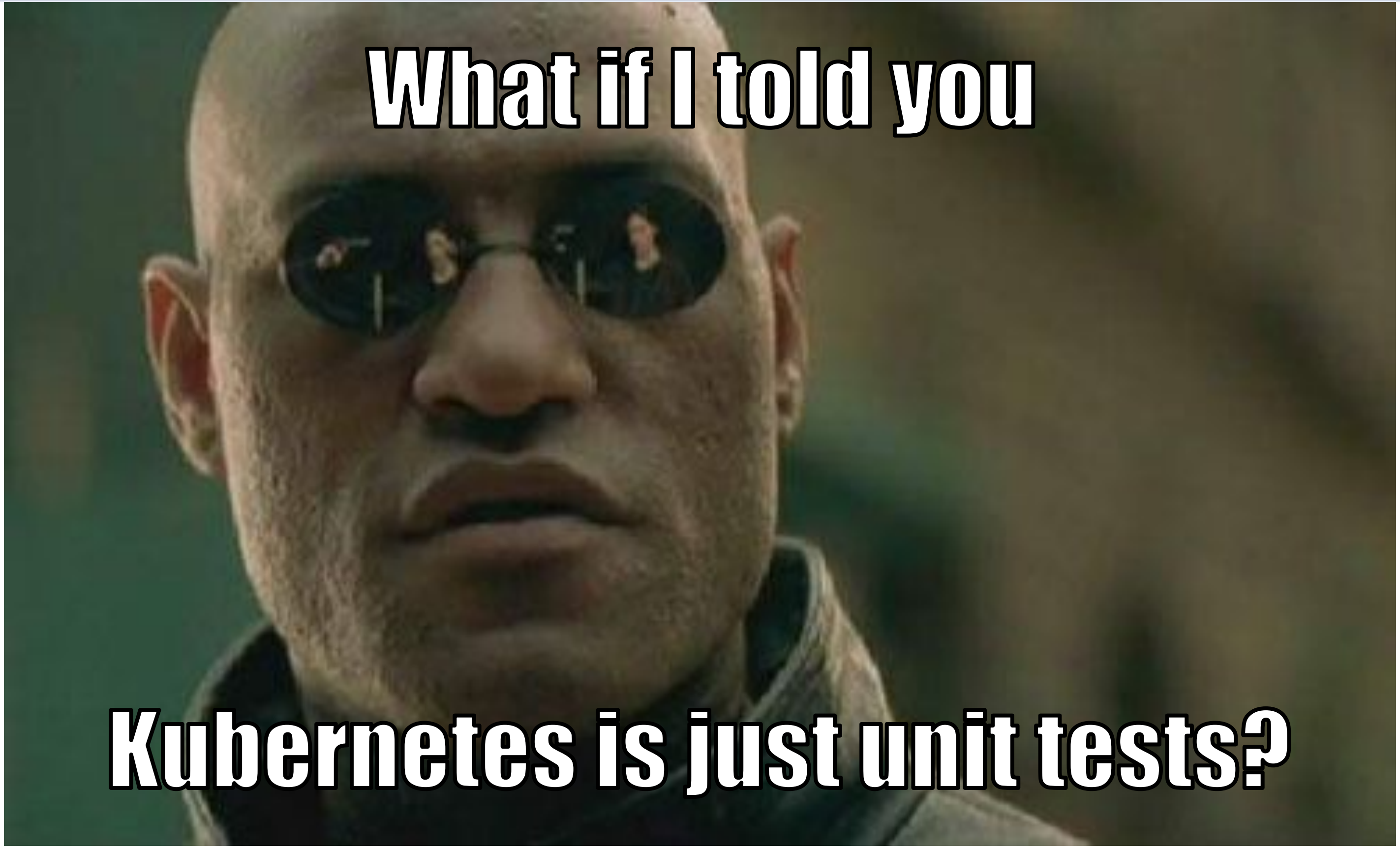
Using e2e coverage

Existing jobs

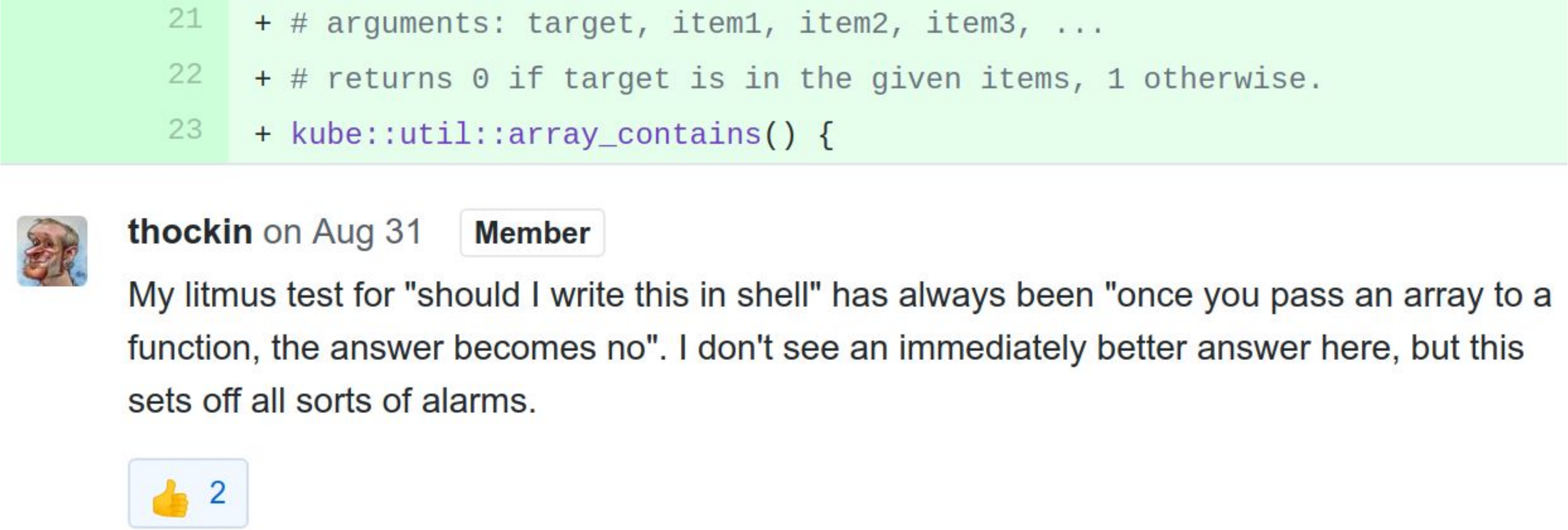
Conformance
Coverage: 29%

All tests
Coverage: 35%

How does any of this work?



How does any of this work?



```
+ # arguments: target, item1, item2, item3, ...
+ # returns 0 if target is in the given items, 1 otherwise.
+ kube::util::array_contains() {
```

thockin on Aug 31 **Member**

My litmus test for "should I write this in shell" has always been "once you pass an array to a function, the answer becomes no". I don't see an immediately better answer here, but this sets off all sorts of alarms.

👍 2

How does any of this work?

```go
func TestMain(m *testing.M) {
    // Get coverage running
    coverage.InitCoverage("${name}")
    // Go!
    main()
    // Make sure we actually write the profiling information to disk,
    // if we make it here.
    coverage.FlushCoverage()
}
```

How does any of this work?

```
cat <<EOF > $(path_for_coverage_dummy_test "${package}")
func TestMain(m *testing.M) {
    // Get coverage running
    coverage.InitCoverage("${name}")
    // Go!
    main()
    // Make sure we actually write the profiling information to disk,
    // if we make it here.
    coverage.FlushCoverage()
}
EOF
```

How does any of this work?

```
create_coverage_dummy_test "${package}"

go test -c -o "$(golang::outfile_for_binary "${package}"
"${platform}")" \
  -covermode count \
  -coverpkg k8s.io/...,k8s.io/kubernetes/vendor/k8s.io/... \
  "${build_args[@]}" \
  -tags coverage \
  "${package}"
```

How does any of this work?

```go
func InitCoverage(name string) {
    destFile = "/tmp/k8s-" + name + ".cov"
    flushInterval := 5 * time.Second

    flag.CommandLine.Parse([]string{"-test.coverprofile", destFile})

    go wait.Forever(FlushCoverage, flushInterval)
}
```

How does any of this work?

```go
func FlushCoverage() {
    tests := []testing.InternalTest{}
    benchmarks := []testing.InternalBenchmark{}
    examples := []testing.InternalExample{}
    var deps fakeTestDeps

    dummyRun := testing.MainStart(deps, tests, benchmarks, examples)
    dummyRun.Run()
}
```

How does any of this work?

- Unavoidably complicated bash
- Code generation of unit tests that don’t test anything… also in bash
- Forcing Go to parse fake command lines
- Creating and running empty unit test suites every five seconds

Questions?

Slides: bit.ly/2S11nyg

Get Involved!

- Learn more about Prow and deploy your own!
- Contribute to Prow!
- Use and contribute to Kind!
- Join the SIG-Testing Slack channel!